SYSTEM INTEGRATION AND ARCHITECTURE

SIA 101

LEARNING MODULE 1
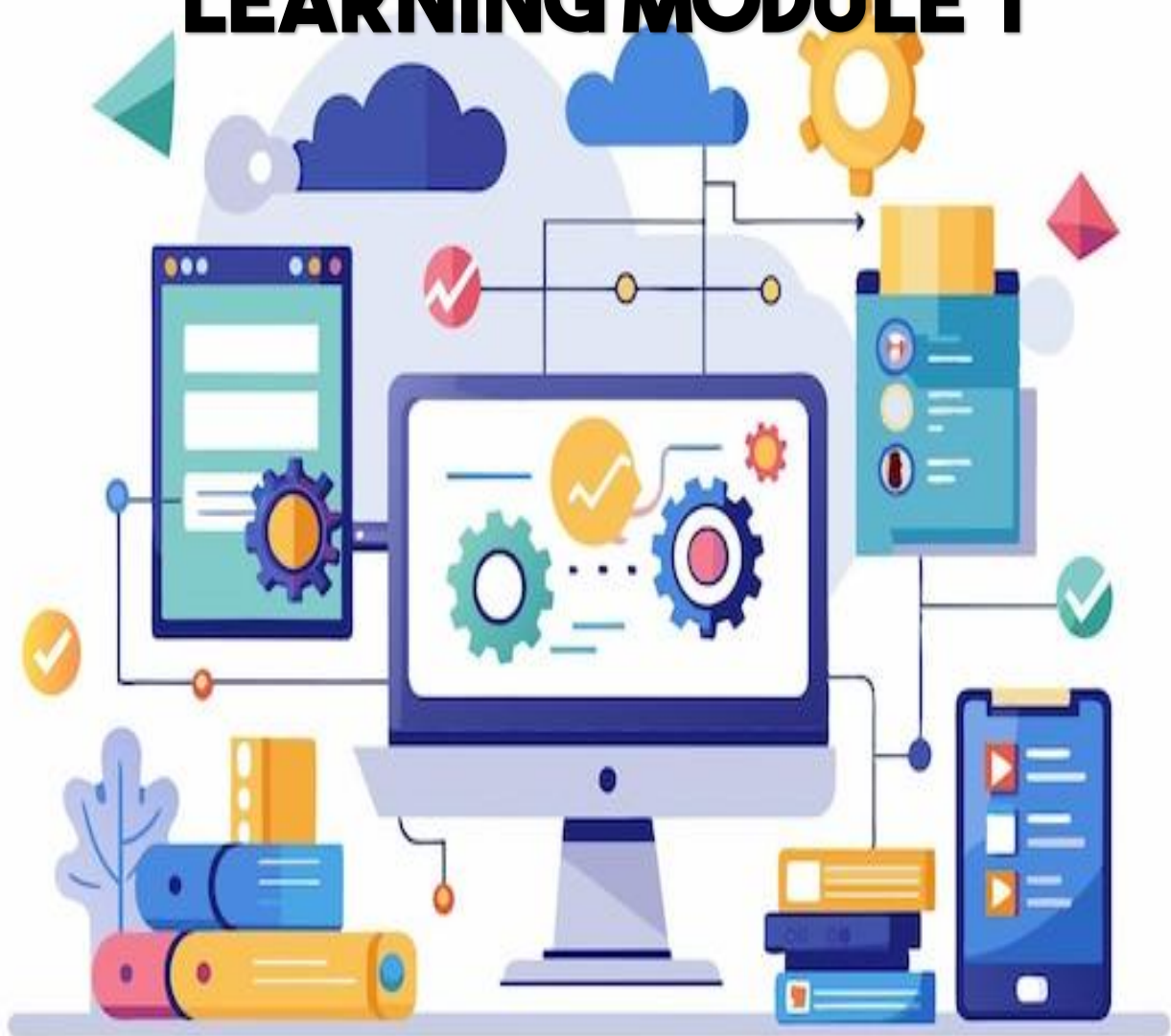
PREPARED BY:

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COURSE OVERVIEW

The course discusses on how to design and build systems and integrate them into an organization, It covers to develop the skill to gather requirements, then source, evaluate and integrate components into a single system, and finally validate the system. It also covers the fundamentals of project management and the interplay between IT application and organizational process.

COURSE LEARNING OUTCOMES:

At the end of this course, the students should be able to:

Knowledge

1. Understand how to design and build systems, the computer hardwares, system softwares and networking
2. Discuss the system architectural concepts and components
3. Explain the advantage, impact and opportunities of programming on professional career and how it can improve their quality of life
4. Discuss the ethical and social issues related to the course title

Skills

1. Enhance a skill on a certain programming language
2. Communicate effectively and professionally
3. Create designs and build systems
4. Adapt critical-thinking and multi-tasking
5. Improve on analysis and decision-making

Values

1. Be responsible before creating or initiating programs and systems

FOREWORD

The Role of IT in an organization is very important especially in enabling business processes. Business capabilities of a modern organization are often determined largely by the capabilities of IT systems. Although modern organization are facing misalignment within its different department and its external parties due to decentralized Information Systems, poor communication within groups, inadequate planning, incomplete requirements.

This challenges creates a critical implications to meet the organization's business goal. To achieve this alignment, the organization should act as a single "big brain" always making best globally and locally optimized business and IT decisions.

This course covers the essential knowledge in which students need to acquire to integrate system effectively. Topics include the construction of strong foundation and understanding on system integration, the different system integration approaches, middleware, and Enterprise Resource Plan (ERP) Systems processes, solving integration problems using patterns, PHP Application Integration, Data Integration, Web Services, and Advanced Web Services.

At the completion of this learning module, students are expected to: (1) analyze the appropriateness of a decision to in-source or out-source IT services given situation by understanding ERP and the importance of System Integration and the different architectures related to it; (2) create a testing environment and design a stress test using appropriate tools and techniques that impact system performance in relation to available ERP and Web Applications, and (3) implement an enterprise integration middleware platform and/or conduct research activities to apply concepts relevant to System Integration and Architecture (SIA).

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INTRODUCTION

As the world continuously advance, business and organizations must keep pace and immediately adopt to these changes in order to take advantage of the benefits that technological advancement brings. In this Course, you will be introduced to important concepts relating to systems integration, enterprise resource planning, silos in business and IT solutions, different information system applications in organizations, the benefits and limitations of system integration and its implications to management.

LESSON OBJECTIVES:

1. To define different terminologies on software and systems integration.
2. To describe the basic concepts of software and systems integration methods.
3. Determine what Silos are all about and the different Information System in an Organization
4. Understand the benefits and limitations of System Integration and its Implications for Management.
5. Define and explain key concepts, approaches, requirement, life cycles, and strategies related to systems integration projects.
6. Describe and apply organizational and managerial issues related to systems integration projects.
7. Explain and utilize key systems integration architecture, planning, methodologies, and Technologies.

ORIGIN OF INFORMATION SYSTEMS

To understand more the information system flow means you can look into the details of an IS project. A new or changed IS development projects come from problems, opportunities, and directives and are always subject to one or more constraints.

- **Problems** may either be current, suspected, or anticipated. These are undesirable situations that prevent the business from fully achieving its purpose, goals, and objectives (users discovering real problems with existing IS).
- **Opportunities** are chances to improve the business even in the absence of specific problems. This means that the business is hoping to create a system that will help it with increasing its revenue, profit, or services, or decreasing its costs.
- **Directives** are new requirements that are imposed by management, government, or some external influence i.e. are mandates that come from either an internal or external source of the business.

➢ In working on a **project**, it must operate in a broad organizational environment and cannot be run isolated. The project managers need to take a holistic or systems view of a project and understand how it is situated within the larger organization.

➢ One important component to be considered is the stakeholders. These are the people involved in or affected by project activities. **Stakeholders** include the project sponsor and project team, support staff, customers, users, suppliers, opponents to the project.

According to the Standish Group's report[1]: A Recipe for Success," the following items help IT projects succeed, in order of importance:

Recipe For Project Success: The CHAOS Ten

The CHAOS Ten

Executive Support	18
User Involvement	16
Experienced Project Manager	14
Clear Business Objectives	12
Minimized Scope	10
Standard Software Infrastructure	8
Firm Basic Requirements	6
Formal Methodology	6
Reliable Estimates	5
Other	5

Each factor has been weighted according to its influence on a project's success. The more points, the lower the project risk.

What makes a project successful? The original CHAOS study, conducted in 1994, identified 10 success factors. We have updated the CHAOS Ten for the year 2000. Although no project requires all 10 factors to be successful, the more factors that are present in the project strategy, the higher the level of confidence.

1. Executive Support: Traditionally the number two spot was occupied by executive support. However, this is now the number one factor in project failure. Executive support influences the process and progress of a project and lack of executive input can put a project at a severe disadvantage.

2. User Involvement: Lack of user involvement traditionally has been the number one reason for project failure. Conversely, the number one contributor to project success has been user involvement. Even when delivered on time and on budget, a project can fail if it does not meet users' needs or expectations. However, this year it has moved to the number two position. It is not that user involvement is less important, but it is just that IT professionals have centered in on this and, in effect, solved this major problem.

3. Experienced Project Manager: Moving up to the number three slot is an experienced project manager. Ninety-seven percent of successful projects have an experienced project manager at the helm.

4. Clear Business Objectives: Moving down one spot to fourth place is having clear business objectives. This is not because clear business objectives are less important, but because evidence shows experienced project managers increase success rates.

5. Minimized Scope: Rounding up the top five is minimized scope. Time is the enemy of all projects. Since scope impacts time, or project duration, they are linked. By minimizing scope, time is reduced and therefore chances for success increase. Minimized scope replaced small milestones, which occupied the number five position in our 1990 CHAOS study. While these two factors are similar, the act of minimizing scope leads to greater success than that of creating small milestones. Small milestones are

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[1] The Standish Group, a US-based research advisory organization.

The CHAOS Report is an influential series of studies published by The Standish Group that analyzes the success rates of IT projects. The reports identify factors contributing to project failure and success, often highlighting issues like poor requirements, lack of user involvement, and insufficient executive support.

within the "minimized scope" category, other factors have been moved to formal methodology and others to categories. Concentrating on the top five will give up 70 success points.

6. Standard Software Infrastructure: Requirements are in a state of constant flux, but the infrastructure needs stability. The Standish Group's research shows that 70% of application code is infrastructure. Some of this code is unique to the application; nonetheless, much of it is code that could be purchased from an infrastructure vendor.

By using standard infrastructure, the application development team can concentrate on business rules rather than technology. Many application development projects fail not in the development of the stand-alone application, but in the integration of existing applications. Here, standard infrastructures can shortcut application integration.

7. Firm Basic Requirements: The key to understanding this item is the word "basic." This refers to base level requirements. By creating a minimal, obtainable base level of requirements and then developing those features, the effect of change will be reduced. Changing requirements is as certain as death and taxes. Delivering minimal features allows users and executive sponsors to see results quickly. As a result, an added benefit is that project managers are better prepared to articulate the needs and priorities of the next phase of the project.

8. Formal Methodology: Does having a formal project methodology increase success rates? Formal project management provides a realistic picture of the project and the resources committed to it. Certain steps and procedures are reproducible and reusable; thus, the tendency to reinvent the wheel is minimized and project-wide consistency is maximized. Lessons learned can be incorporated into active projects. The process encourages a go or no-go decision checkpoint. A project team can proceed with a higher level of confidence or steps can either be halted or altered to fit changing requirements. This ability to adjust in real time enhances project skills and reduces project risk. CHAOS research shows that 46% of successful projects used a formal project management methodology, compared to 30% of challenged and failed projects. Therefore, this factor should increase chances of success by about 16%.

9. Reliable Estimates: When developing a systematic approach toward project estimating, again, being realistic is necessary. Estimating is just plain hard. Add to the difficulty the developing and purchasing of components and their integration into existing applications, package applications and outside services. As mentioned earlier, IT managers must use all their collective knowledge and experience to come up with estimates that reflect the true effort required.

10. Other Criteria: In last place is a collection of other factors. These factors include small milestones, proper planning, competent staff and ownership. In the past, each of these factors was represented as a category by itself.

There are over 300 possible queries across these ten categories. Using case-based reasoning techniques,The Standish Group assesses project risk.This is first done by profiling the project and then asking 100 questions related to the profile. The profile and the answers are then matched against a set of the 30,000 cases to calculate the project's risk.

The CHAOS Ten success factors continue to be a valuable tool to estimate project success potential. While there is no magic formula that can guarantee project success, ensuring the presence of the CHAOS Ten can increase the odds in one's favor.

INFORMATION SYSTEM IN ORGANIZATIONS

"Information Systems are a critical component of a successful organization today."

IMPORTANCE OF IT IN ORGANIZATIONS

Most organizations nowadays are critically dependent on the daily operations of Information Technology (IT). Large Companies/Organizations often to run and maintain thousands of various IT systems to enable their business processes. The influence of IT systems on business models is continuously increasing.

The role of IT in an organizations has evolved from purely technical and supporting action to a more strategic or even business-enabling function. Information systems often become a backbone of major organizational changes and transformations.

The capital investment in IT systems, IT budgets and infrastructure are steadily increasing over time. Through the decades, the Information systems become more powerful, ubiquitous, diverse and affordable. The computing power and storage capacity of IT systems are exponentially increasing. Today, Business Applications can be deployed on dedicated servers, can be hosted in the cloud, and can run web browsers and even installed on hand held devices. The relative price of IT systems are getting affordable making it more accessible.

The purpose of IT is not only limited on installing the appropriate software and hardware in an organization rather improving the quality of business processes that requires consistent and coordinated changes in the three broad organizational aspects:

- People
    - Trainings and Education to system users.
- Processes
    - Introducing new improved business processes Enabled by system
    - Decision Making procedures and rules.
- Technology
    - Setting up new IT systems and required infrastructure.
    - Providing Technical and helpdesk support to users.

Information systems can help organization executes their business strategies and gain competitive advantages in terms:

- Operational Excellence and Cost Leadership

- Product differentiation and leadership

- Customer Intimacy and focus.

UNDERSTANDING ORGANIZATIONS

We can analyze a formal organization using the following 4 (four) frames;

Structural frame:	Human resources frame:
Focuses on roles and responsibilities, coordination and control. Organizational charts help define this frame.	Focuses on providing harmony between needs of the organization and needs of people.
Political frame:	**Symbolic frame:**
Assumes organizations are coalitions composed of varied individuals and interest groups. Conflict and power are key issues.	Focuses on symbols and meanings related to events. Culture is important.

The project managers are significant stakeholders because they must take time to identify, understand, and manage relationships with all project stakeholders. Using the four frames of organizations can help meet stakeholder needs and expectations and analyze a formal organization to understand such. Senior executives are very important stakeholders.
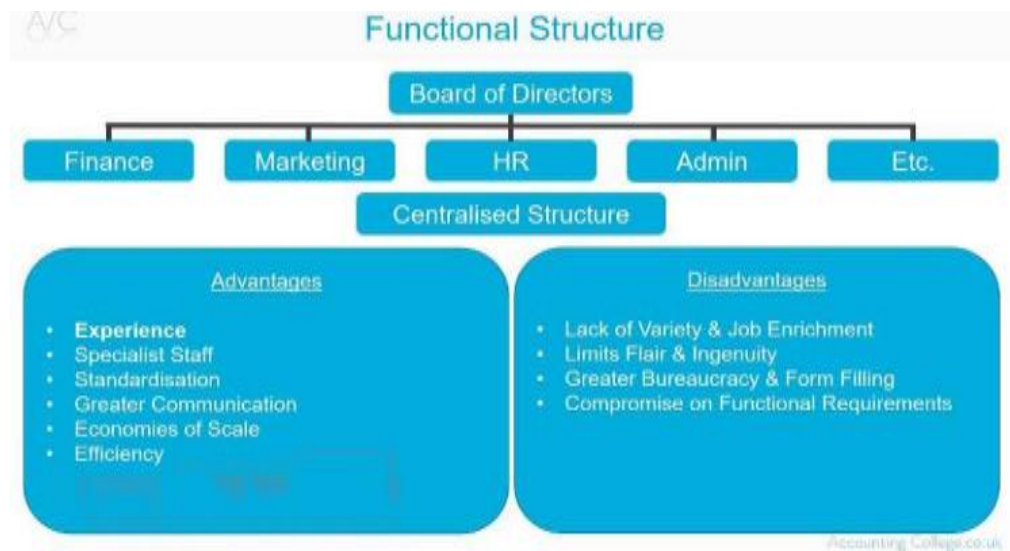
As most people understand what organizational charts are, many organizations focus on the Structural Frame. Many new managers try to change organizational structure when changes are needed.

The basic Organizational Structure depends on the company and/or the project. This structure helps define the roles and responsibilities of the members of the department, workgroup, or organization. It is generally a system of tasks and reporting policies in place to give members of the group a direction when completing projects. A good organizational structure will allow people and groups to work effectively together while developing hard work ethics and attitudes.
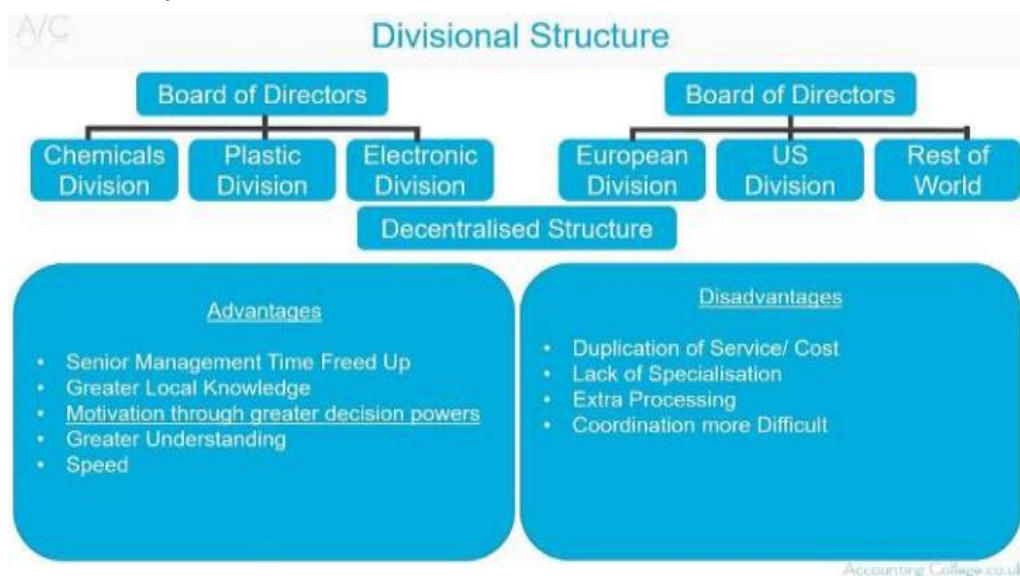
There are eight known organizational structure of project management (organic, line, line & staff, functional, divisional, matrix, project, and virtual). However, I just want you to focus on the four general types of basic organizational structure are deemed viable in the nature of project development - **functional, divisional, matrix,** and **project-based**.
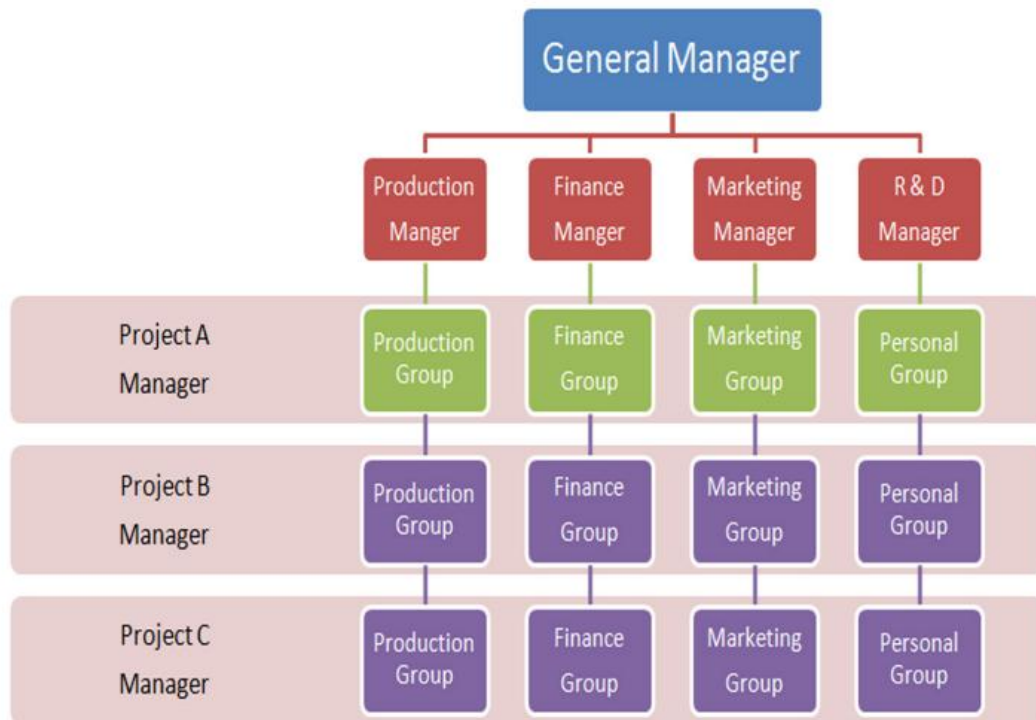
TYPES OF BASIC ORGANIZATIONAL STRUCTURE

1. The **Functional Organization** groups workers based on their area of specialization. This structure is an extension of the Line Organization. The functional manager leads the team and manages all the operations or businesses. The structure positions departments vertically and disconnected from others. The department heads manage communication between the top management and his subordinates.

Functional Structure

Board of Directors

Finance | Marketing | HR | Admin | Etc.

Centralised Structure

Advantages
- **Experience**
- Specialist Staff
- Standardisation
- Greater Communication
- Economies of Scale
- Efficiency

Disadvantages
- Lack of Variety & Job Enrichment
- Limits Flair & Ingenuity
- Greater Bureaucracy & Form Filling
- Compromise on Functional Requirements
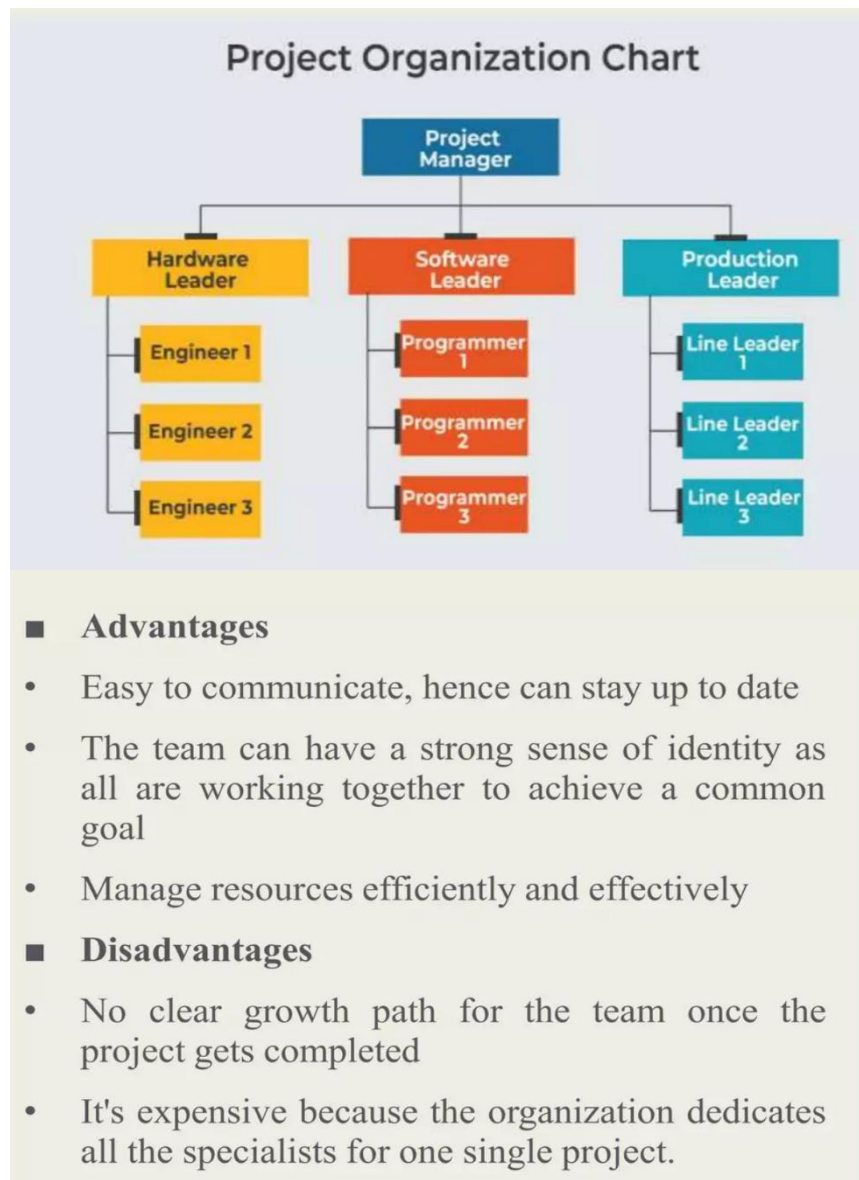
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2. This type of organizational design focuses on service lines like products, customers, area, and time. Since they operate as small organizations, they are called "self-contained structures." – a **divisional structure**. The team members work in different departments. This setup splits the employees into segments based on products, markets, or services. This, they work independently on divisional goals. But all divisions collectively meet the organizational policies and business objectives.

Divisional Structure

Board of Directors

Chemicals Division | Plastic Division | Electronic Division

Board of Directors

European Division | US Division | Rest of World

Decentralised Structure

Advantages
- Senior Management Time Freed Up
- Greater Local Knowledge
- Motivation through greater decision powers
- Greater Understanding
- Speed

Disadvantages
- Duplication of Service/ Cost
- Lack of Specialisation
- Extra Processing
- Coordination more Difficult

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3. This one is the combination of a projectized and functional organization also known as **Matrix structure**. This hybrid organization overcomes the limitations of each organization. Here, both the functional and project managers share their respective authorities. This type of organization is most useful when workers must share available resources. The combination achieves high efficiency and better usage of available resources. Also, they adapt better to the changing trends.

Advantages vs. disadvantages of matrix organization

Advantages	Disadvantages
✓ Clear project objectives	✗ Complex reporting style
✓ Efficient use of resources	✗ Slow response time
✓ Free-flowing information	✗ Conflicting guidance
✓ Training for project managers	✗ Potential power struggles
✓ Retention of teams	✗ Juggling priorities

4. **Project organization** is a temporary setup formed for specific projects. It's also called "*projectized organizational structure*." The project manager assigned for the project is the head of this structure. Once the project is complete, the project manager may choose to dismantle this setup or move it to form a new project. In the case of a new project, the project manager might have to reshuffle the staff to fit the new plan. You will hire resources or specialists from different functional departments.

Project Organization Chart

■ **Advantages**

• Easy to communicate, hence can stay up to date

• The team can have a strong sense of identity as all are working together to achieve a common goal

• Manage resources efficiently and effectively

■ **Disadvantages**

• No clear growth path for the team once the project gets completed

• It's expensive because the organization dedicates all the specialists for one single project.

FUNCTIONAL SILOS

A **silos** is an airtight pit or tower for preserving foodstuffs, according to Webster's definition. Silos are simply segregated functioning units that are cut off from the rest of the environment. In a firm, functional silos are groups of personnel organized by function that operate independently of one another and without cross-collaboration. (Monday.com, nd). Classification of functional silos include horizontal silos and vertical silos.

Horizontal Silos

Henry Fayol, a management philosopher, was the first to separate functionalized organizations into five fundamental areas: planning, organizing, coordinating, commanding, and controlling in the early 1900s. Luther Gulick expanded and theorized Fayol's categorization in the 1930s, resulting in the POSDCORB functional model (planning, organizing, staffing, directing, coordinating, reporting, and budgeting). Starting in the late 1930s, the POSDCORB category became increasingly popular, resulting in a set of formal organization roles such as control, management, supervision, and administration. The language of organizational functions evolved over the following 50 years, for example, from planning to management to strategy, but the principle of organizing complicated tasks into structured functions persisted for control and coordination purposes.

| Organization						
Planning	Organizing	Staffing	Directing	Coordinating	Reporting	Budgeting

Horizontal Silos
Image Source: Adapted from Bernard, C. (1938). The Functions of the Executive. Cambridge: Harvard University Press.

VERTICAL SILOS

In the late 1960s, Harvard University's Robert Anthony discovered that businesses split responsibilities in hierarchical stages, from strategic planning through managerial control and operation control. Most institutions, for instance, have upper executives such as CEOs and presidents who manage long-term strategic plan, so although middle level leadership (e.g., vice presidents or general managers) concentrates on strategic concerns and the implementation of company's strategy to ensure that the company meets its organizational plans. The job of middle positions (for example, supervisors) is to concentrate on the business's daily operations functions. Although not independent organizational roles, this vertical category does entail a different set of activities.
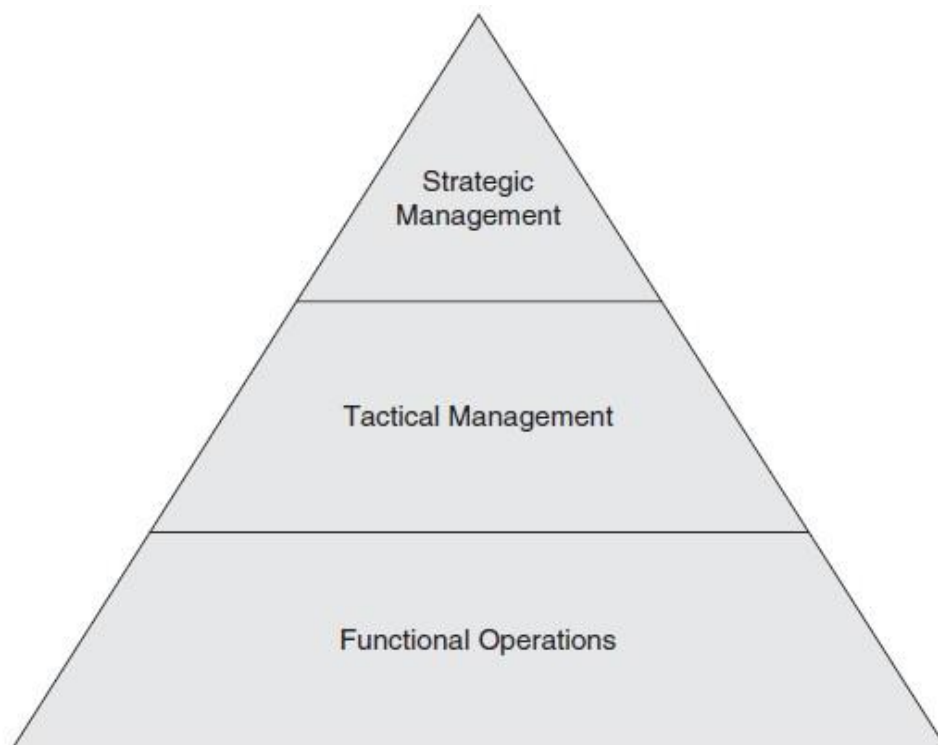
Vertical Silos
Image Source: Motiwalla & Thompson, 2012

As businesses get larger and more complicated, they prefer to split operations down into manageable units and give responsibility for these tasks to employees, allowing them to manage complexity while focusing on tasks that boost productivity and efficiency.

## INFORMATION SYSTEMS (IS) IN ORGANIZATIONS

Today's successful organizations rely heavily on information systems. Information systems (IS) are important because they process data from corporate inputs to provide information that can be used to manage business operations. Some of the applications of information systems in organizations are the following: Business Communications System, Business Operations Management, Company Decision-Making, and Company Recording-Keeping (Markgaf, 2019).

In the core and secondary operations of an organization's value chain, information systems play a critical role. The development of IS implies that its primary purpose has been to serve the organization's changing information demands. Information Systems assist company processes including such accounting, finance, marketing, customer service, human resource management, operations, and manufacturing by providing a high level of computer automation (Supporting horizontal silos). Management is divided into three levels: strategic, middle, and operational, with information systems providing analytical and decision-making assistance (Supporting vertical silos) (Motiwalla & Thompson, 2012). Each company function and management level have its own set of requirements.

FUNCTIONAL SILOS AND INFORMATION SYSTEMS IN AN ORGANIZATION

Each functional area has its own set of information and reporting demands. There are numerous layers of management in each functional area of a company, which needing varying levels of analysis and knowledge depth. Organizations established diverse information systems to support each key operation and duty in order to boost efficiency and production.
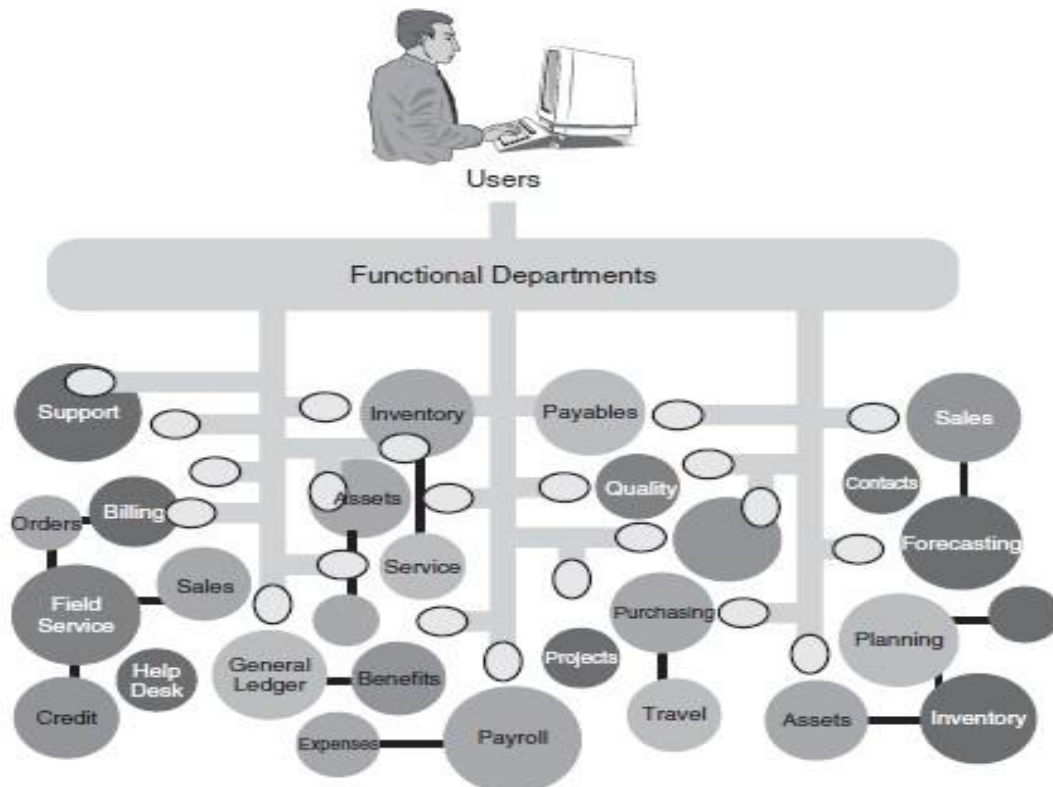
Functional Silos Image Source: Motiwalla & Thompson, 2012

Each management level has different information requirements.

Management levels and information requirements (Image Source: Motiwalla & Thompson, 2012)

INFORMATION SILOS AND SYSTEMS INTEGRATION

Over time, corporations developed a jumble of unconnected, non-integrated systems, which resulted in bottlenecks and slowed production. Organizations must be nimble and adaptable, and their information systems must include data, applications, and resources from several departments. A data silo system is inefficient, incorrect, and costly. Everyone has bottlenecks as a result of the system, and information is not available in real-time.

Organizations must be customer-centric in order to compete effectively. This necessitates cross-functional collaboration between the company's accounting, marketing, and other divisions. People and resources from diverse functional areas can collaborate and share information at a certain level of the organization through cross-functional integration. By allowing information to flow freely from one unit to another, the cross-functional organizational structure breaks down functional silos.

DEFINING SYSTEM INTEGRATION

What is System Integration?

Integration is the act of bringing together smaller components or information stored in different subsystems into a single functioning unit.

In an IT context, integration refers to the end result of a process that aims to combine different -- often disparate -- subsystems so that the data contained in each becomes part of a larger, more comprehensive system that, ideally, quickly and easily shares data when needed. This often requires organizations to build a customized architecture or structure of applications to combine new or existing hardware, software and other components.

System integration is the process of integrating software and hardware modules into a single cohesive infrastructure, allowing all components to function as a whole. System integration is the process of taking separate working systems, often from different vendors, and making them work together as one.

An integrated ERP system is a great solution for businesses that are slowed down by working with different, independently functioning software and lose a lot of time due to re-entering data into each of the tools. If you want to be successful, you must increase your company's productivity and improve its workflow. Integrating systems is an excellent way to achieve these objectives; however, the development process can be lengthy and complex.
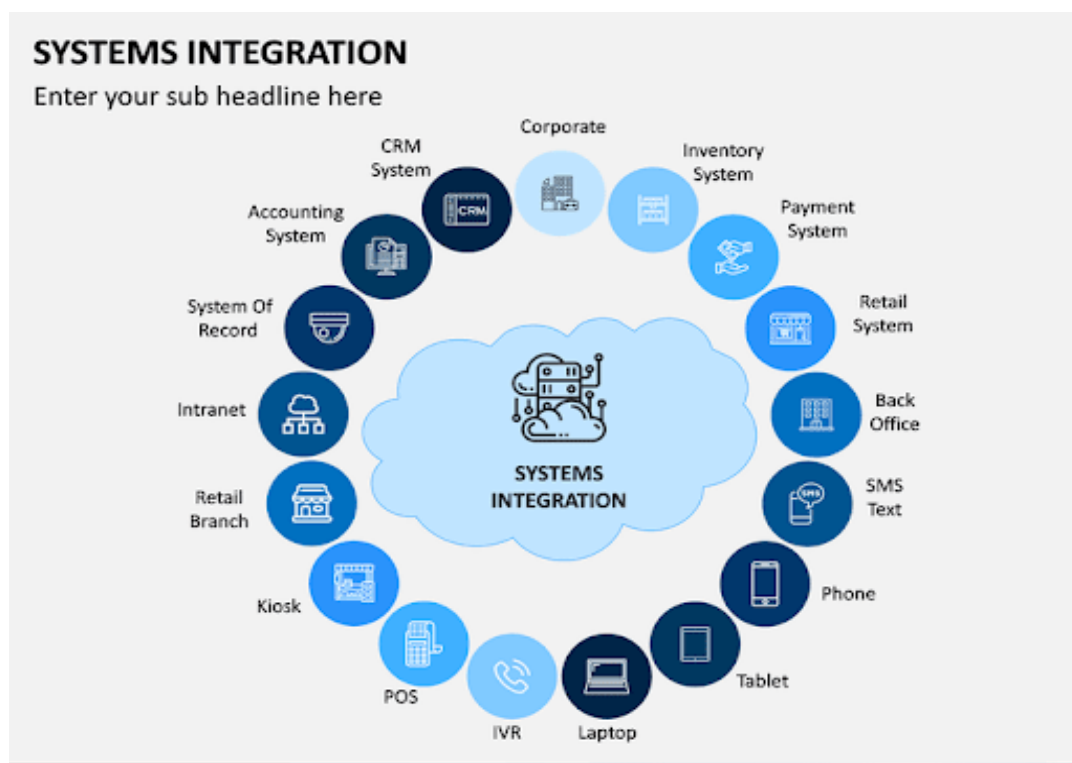
Sample of Application for Integration

The goal of this dynamic integration is typically to have the company's various IT systems communicate with one another in the background. This is done to save effort and time spent on manually sharing information with other departments and components of the organization, including upper management. As a result, the organization will benefit from increased information flow speeds and lower operational costs due to system integration.

Furthermore, system integration types link the organization to third-party stakeholders such as suppliers, customers, and shareholders. System integration enables customers to track finished goods inventory, suppliers to track raw material levels, and shareholders to view the company's position at a glance in real-time via a dashboard.

All of these requirements can be easily met by utilizing system integration provided by a reputable systems integrator. The following are some **Applications of System Integration**:

1. **Productivity is increased:**
   Integration of CRM with the ERP system enables centralized control over daily processes, increasing the overall workflow's efficiency. Employees can use all the apps and data they need from a single point of entry, allowing a company to complete more work in less time.
2. **More precise and reliable data:**
   Data is updated simultaneously across all system components, keeping all departments on the same page.
3. **Decisions are made faster:**
   Data is no longer dispersed across disparate storage systems. As a result, you don't have to manually download and export it to the centralized repository to perform analytics.
   Instead, by taking a holistic view of all information, you can extract useful business insights and make better decisions with integral ERP faster.
4. **Cost-effectiveness:**
   ERP integration software is frequently less expensive than replacing all disjointed parts with a new single system, not to mention the difficult process of establishing a new computing infrastructure.

FUNDAMENTAL METHODS FOR SYSTEM INTEGRATIONS

Organizations can choose from different system integration methods or integration approaches. Each method defines a different architecture for linking applications. For instance, point-to-point integration links systems directly, while a hub-based approach uses a central mediator. In practice, many projects use a hybrid of these methods depending on needs and scale.
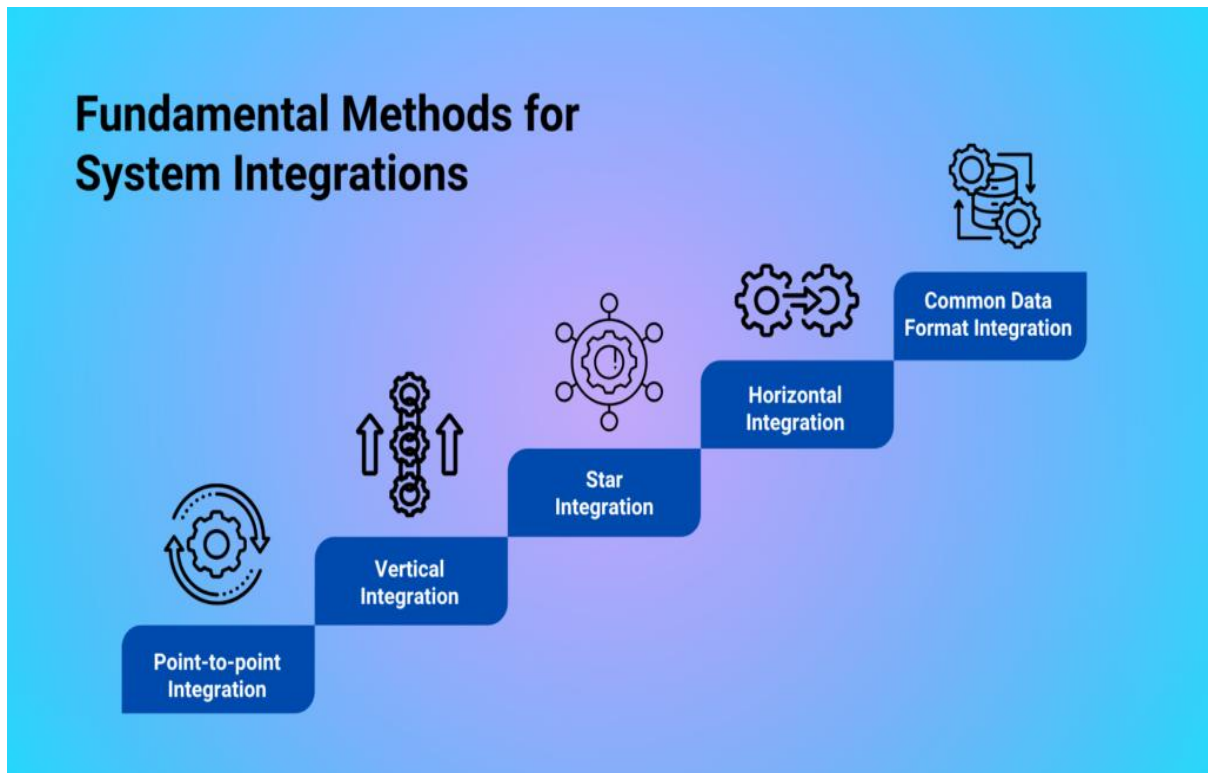
1. **Point-to-point Integration**
    This method connects each pair of systems directly, enabling data to flow between them. It's literally a system-to-system link. It's simple to set up for a small number of systems and has a low upfront cost, with fast, direct communication. However, it rapidly becomes unmanageable ("spaghetti" architecture) as connections multiply. Every new system needs a link to all others, and maintenance grows complex.

Pros:
*   Simple for a few systems
*   Low initial cost
*   High performance (no middleware)
*   Quick setup for urgent needs

Cons:
*   Poor scalability with many systems
*   Hard to maintain with many links
*   No central error handling or logging
*   Duplication of data logic

Best Use Case: Quick, small-scale integration (e.g., linking a website to a CRM (Customer Relationship Management) for a small business).

Point-to-Point Integration

2. Vertical Integration

Systems are arranged in a linear pipeline, each step triggering the next. This mirrors a business workflow end-to-end while enabling full process automation with clear data flow (for example, order → manufacturing → shipping in sequence). But it's rigid: any break in the chain halts the whole process, and steps can't be easily reused outside the pipeline.
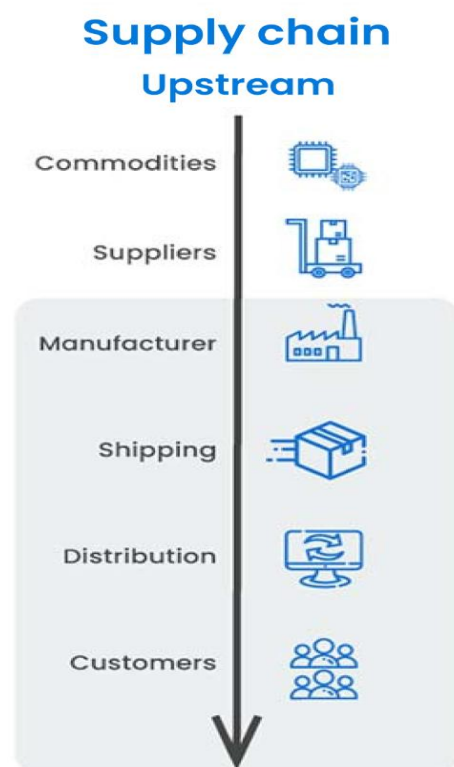
Pros:

- Seamless end-to-end workflows
- Mirrors actual business processes
- Each stage automatically triggers the next

Cons:

- Rigid, hard-to-reuse to reuse parts in other workflows
- Entire chain affected by one failure
- Creates silos by process

Best Use Case: Sequential pipelines (e.g., manufacturing assembly line or order fulfillment process).

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3. **Star Integration**

   Multiple applications are connected as needed in a "star" network, but not every system is linked to every other. It's a collection of point-to-point links forming an ad-hoc network. This is flexible and doesn't require a central hub. You only connect applications that need to interact. However, it can still become complex if many links exist, making the architecture hard to visualize and manage. Data and logic may end up duplicated across connections.

   Pros:
   - Flexible; only link systems that need to communicate
   - No single point of failure
   - No single vendor lock-in for connections

   Cons:
   - Complexity grows quickly with more links
   - Difficult to ensure consistency without central control
   - Potential for redundant data flows

   Best Use Case: Moderate-scale integration (e.g., linking a CRM, order management, and billing system together).
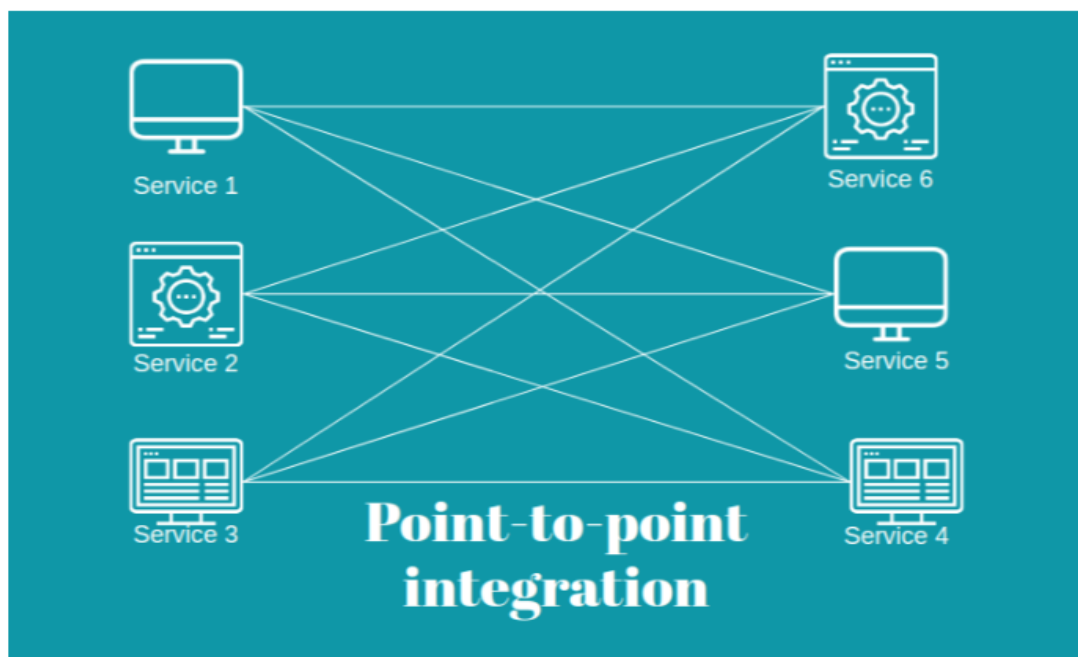
Star Integration

4. **Horizontal Integration**

   Horizontal integration is a business-growth strategy that companies pursue to expand their footprint in the marketplace. In a horizontal integration, a business combines forces with another company that offers similar products or services. This type of integration differs from vertical integration, in which a company expands either upstream or downstream by acquiring firms in an earlier or later phase of the value chain, such as a manufacturer taking over a distributor or merging with a retailer. In contrast, a horizontal integration involves a company acquiring or merging with another company in the same industry that operates at the same point in the value chain. The combination of the two businesses typically results in a single company that sells more products and/or services than either organization could individually and thus has a more dominant role in the marketplace.

   Pros:
   - Reduced competition.
   - Increased market share.
   - Expanded customer base.
   - Revenue growth.
   - Improved efficiencies.
   - Greater product and service differentiation.
   - Access to new markets.
   - Increased market power.

   Cons:
   - Operational integration challenges
   - Leadership or culture clashes
   - Reduced flexibility
   - Regulatory and legal issues
   - Failed Expectations

   Best Use Case: Large enterprises with many integrations, often using a commercial ESB or integration suite (e.g., connecting dozens of internal and external apps).

5. **Common Data Format Integration**

In this method, all systems agree on a single, shared data format (canonical model). Each system converts its data to and from this common format. This drastically reduces the number of data translations needed. It simplifies adding new systems—each only maps to the common format. However, defining and maintaining one global schema is challenging. It may require significant upfront work and strict governance to ensure every system adheres.

Pros:

- Fewer data transformations needed overall
- Simplifies adding new systems (one standard to follow)
- Improves data consistency and quality across applications

Cons:

- Must define/maintain a global schema (complex)
- Can be inflexible for unique data needs in each system
- Significant initial effort to implement the shared format

Best Use Case: Enterprises with many interdependent apps (e.g., across departments) that can adopt a common data model, often in combination with an ESB or data warehouse.

TYPES OF SYSTEM INTEGRATION

There are several types of system integration, each serving different needs. The classification below defines key integration types and provides an example of each. These system integration examples illustrate how organizations link disparate systems.
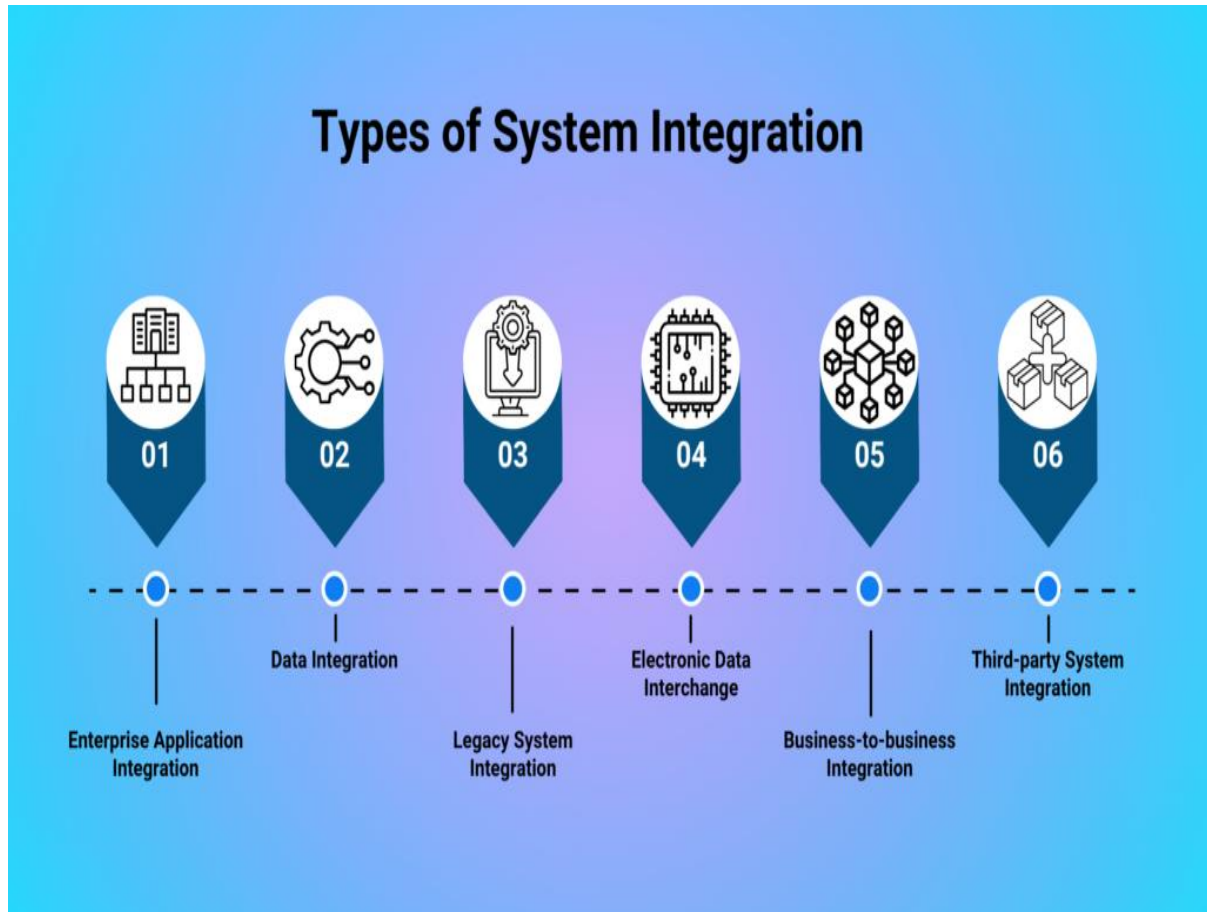
1. **Enterprise Application Integration (EAI)**
   Enterprise Application Integration connects an organization's core applications (e.g., ERP, CRM, or SCM) using specialized middleware. It ensures that data and updates in one application propagate automatically to others. This approach breaks down silos so all integrated systems share current information.
   Example: A sales management system is integrated with an ERP, so that when a sales order is confirmed, it automatically triggers inventory validation and billing processes without manual intervention.

2. **Data Integration (DI)**

Data Integration combines information from multiple sources into a single repository, typically for analytics or reporting. Processes like ETL (extract-transform-load) consolidate data in a central warehouse or data lake. This breaks down silos so all departments work with the same information.

Example: A firm combines data from customer relationship management, finance, and operations systems into a centralized analytics platform. This enables executives to access consolidated performance dashboards and make data-driven decisions.

3. **Legacy System Integration**

Legacy system integration connects new applications with older, often outdated systems. It usually requires custom adapters or wrappers since legacy systems may not support modern standards. The goal is to let existing data and functionality coexist with new technology, extending the life of legacy systems.

Example: An organization continues to rely on an on-premise mainframe for key business data. To enable digital workflows, the legacy system is integrated with a new web-based application so that users can view and update data through a modern interface without altering the original system.

4. **Electronic Data Interchange (EDI)**

Electronic Data Interchange is a set of standards for exchanging business documents (like orders and invoices) between companies electronically. Using standard formats (EDIFACT, ANSI X12), partner systems can automatically process transactions. EDI replaces paper-based processes by automating document exchange, speeding up operations like ordering and invoicing.

Example: When a retailer's stock reaches a predefined threshold, a purchase order is automatically sent to the supplier. The supplier, in turn, sends an invoice and shipping notice electronically, eliminating manual emails and paperwork.

5. **Business-to-business Integration (B2B)**

B2B integration links the systems of two or more separate organizations. It often leverages EDI or APIs to automate cross-company processes like ordering, fulfillment, and inventory updates. Successful B2B integration requires agreeing on data formats and security so both partners can seamlessly exchange information.

Example: A manufacturing company integrates its order processing system with a logistics partner's tracking system. When shipments are dispatched, the logistics provider automatically updates the delivery status, which the manufacturer and end customer can view in real-time.

6. **Third-party System Integration**

Third-party integration connects an organization's systems to external services or platforms (often cloud-based). It uses APIs or connectors to securely exchange data between internal applications and outside providers. This lets businesses add

specialized functions (like payment processing or shipping) without building them in-house.

Example: A company integrates its internal customer database with an external payment gateway, support ticketing system, and email marketing service. This allows seamless payment processing, faster customer support, and automated marketing communication—all triggered by events in the internal system.

BENEFITS OF SYSTEMS INTEGRATION

At the heart of systems integration is building a central repository for shared data, but the impact goes much further. Shared data provides the foundation for a smarter, more agile organization that collaborates more efficiently across departments to provide greater focus on customer needs. Successful systems integration can result in the following important benefits.
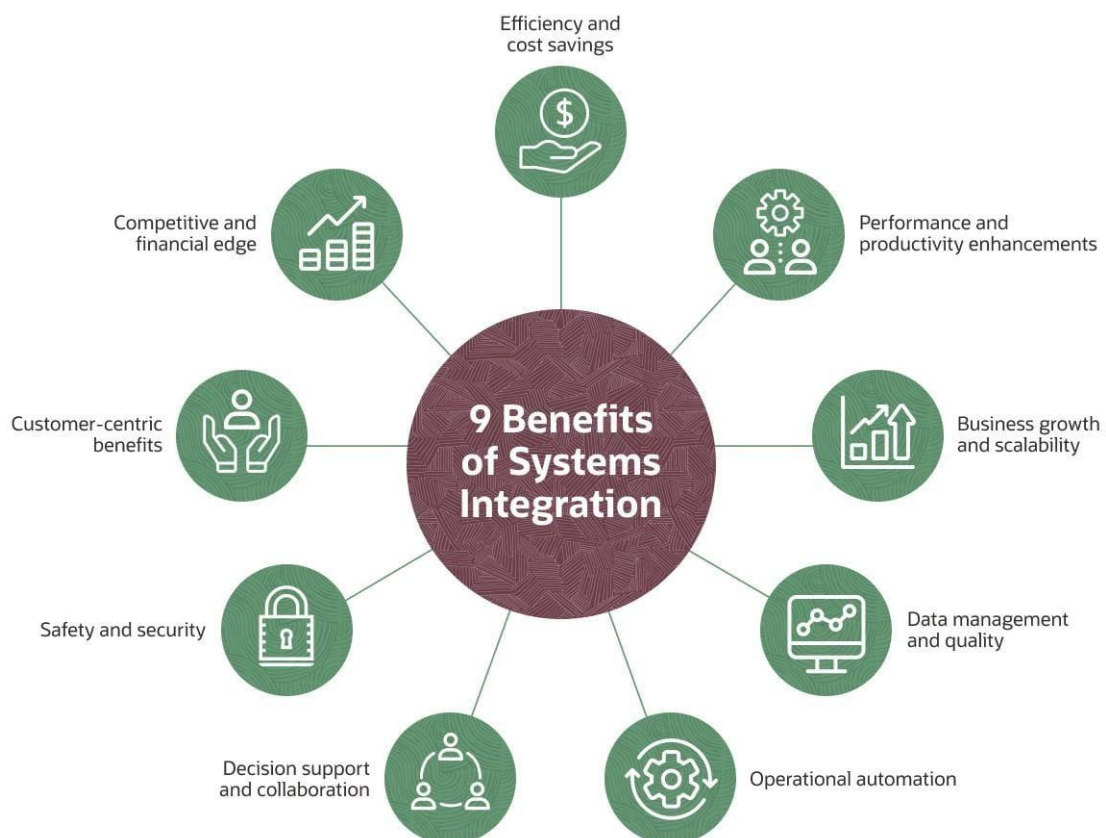
Systems integration builds a harmonious application ecosystem that leads to a smarter, more agile organization.

1. **Efficiency and Cost Savings**

   When systems aren't integrated, process inefficiencies and rising costs become an issue. For example, workers in different departments often end up entering the same data into disparate systems. Not only does that create extra work, but it also increases the risk of errors and data discrepancies. Systems integration streamlines operations by automating data entry. When data is entered into one system, it automatically populates in other systems, reducing labor costs and errors.

   To maximize efficiency and cost savings from systems integration, companies should focus on incremental integration, starting with the most critical systems to generate quick wins and build momentum. In addition, leveraging cloud-based integration platforms can offer scalability and reduce the need for expensive hardware investments, further reducing costs.

2. **Performance and Productivity Enhancements**

   Separate systems almost inevitably lead to manual data entry across departments, as well as data silos and an inability to access real-time information. In a business environment that demands agility, this can dramatically hinder performance, productivity and decision-making. A primary benefit of systems integration is the creation of a central repository of data and automated workflows among systems, which allows employees to access consistent information whenever they need it, boosting productivity. Integrating a customer relationship management (CRM) system with an enterprise resource planning (ERP) system, for example, can streamline customer service and order fulfillment processes, impacting both employee efficiency and customer satisfaction. Additionally, using data analytics tools with consolidated data extends the benefits of systems integration by improving data-driven decisions.

3. **Business Growth and Scalability**

   As companies add new applications to their IT stacks, they need to be careful that disconnected data doesn't create bottlenecks in decision-making processes, which can severely limit agility, growth and scalability. Systems integration makes sure all systems communicate seamlessly, thereby fueling business growth by allowing companies to adapt and expand operations without the constraints of disjointed information systems. For example, integrating sales, inventory and customer service systems facilitates real-time updates on stock levels. This creates more efficient and scalable inventory management and provides customer service representatives with immediate access to accurate product information to deliver better customer experiences.

4. Data Management and Quality

Storing data in siloed, disconnected applications is likely to create data inconsistencies, inaccuracies and inefficiencies that lead to poor decision-making and raise the potential for compliance violations. Integrated systems improve data quality by automating data processes, which reduces the risk of human error and ensures consistent, accurate information across multiple systems — a crucial factor for reliable analytics and strategic planning. Systems integration also consolidates data into a single repository, creating a single source of truth for everyone who uses it.

This comprehensive approach to data management fuels better analysis, forecasting and strategic decision-making. As a result, businesses benefit from improved operational efficiency and more reliable insights.

A helpful tip for improving data management and quality: Companies should implement data governance practices from the outset to ensure that data remains clean, secure and well-managed as systems are integrated.

5. Operational Automation

A recent survey by Digibee[2] found that enabling automation is one of the top three reasons why businesses pursue systems integration. In doing so, they can lay the groundwork for companywide automation to streamline workflows and processes that were previously manual and time-consuming, such as data entry and synchronization across platforms. For example, when a customer places an order, an integrated system can automatically update inventory, notify the shipping department and generate an invoice without human intervention. This not only speeds up operations, but also reduces the likelihood of errors and ensures that all parts of the business have access to real-time data.

By automating routine tasks, systems integration frees up employees to focus on more strategic work, enhancing overall productivity and business agility. To optimize operational automation during systems integration, companies need to review the technical specifications of current software before initiating the integration process. This can help identify optimal areas for automation, as well as potential bottlenecks.

6. Decision Support and Collaboration

Disjointed systems create disjointed data. Manual data syncing and a lack of real-time reporting can lead to slower decision-making, inefficiencies and minimal collaboration among teams. In fact, recent research from AI search engine

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[2] **Digibee** is an enterprise integration platform-as-a-service (eiPaaS) that enables you to build flexible, highly scalable integration architecture by connecting data, systems, and applications within and beyond your organization.

Company Coveo[3] shows that workers spend an average of 20 hours per week searching for information. Systems integration improves decision support and collaboration by breaking down data silos, automating data synchronization and providing a centralized platform for real-time information sharing. Seamless access to real-time data builds cross-system communication to empower better decision-making. It also encourages teams to work cohesively and make decisions based on accurate, up-to-date information, ultimately driving growth and customer satisfaction.

7. **Safety and Security**

   Disconnected systems leave businesses vulnerable to data breaches and cyber threats because they often lack unified security protocols, making it easier for bad actors to exploit gaps and access sensitive data. This can result in serious financial and reputational damage. According to Statista, the average cost of a data breach in the United States last year amounted to $9.48 million. Systems integration augments safety and security by creating a unified platform for managing and monitoring diverse systems, which simplifies the detection of, and response to, security incidents. For example, integrating security protocols across systems ensures consistent application of firewalls, encryption and access controls, which fortify defenses against unauthorized intrusions. Companies should adopt a proactive approach to security by conducting regular risk assessments and implementing a robust framework tailored to their integrated environments.

8. **Customer-Centric Benefits**

   Fragmented, siloed customer data can result in poor communication, inefficient processes and a lack of personalized service. This can ultimately lead to customer dissatisfaction and loss of business. Systems integration is designed to help businesses provide a seamless and personalized customer experience by making sure customer data is consistent across all touchpoints, thereby facilitating a more cohesive and satisfying customer experience. It enables businesses to have a complete view of their customers, which creates significant benefits, including improved communication, increased customer retention and loyalty, more effective targeted marketing and greater upselling opportunities.

8. **Competitive and Financial Edge**

   The competitive and financial benefits of systems integration are substantial. By providing a unified view of data from various systems, companies can work smarter, using data analysis tools to identify areas for improvement and make informed decisions based on accurate and consistent data. Systems integration also improves customer service and communication by breaking down silos, centralizing information and streamlining processes. Additionally, connecting

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[3] **Coveo,** a Canadian software as a service company that provides e-commerce and enterprise search software for ecommerce, customer service, digital workplaces, and websites.

systems and automating tasks lead to more efficient operations, lower costs and improved productivity, all of which boost the bottom line.

Challenges Faced in System Integration

For system integrator companies, the system integration process presents numerous challenges. Thorough preparation is required for successful system integration. Even relatively simple projects can become difficult and complicated at times.
These activities necessitate expertise, so service integrators always develop a detailed plan with a step-by-step checklist to ensure success. Let's look into the most important challenges of system integration:

1. **Examining test environments**
   When it comes to software development, testing and optimization are never-ending processes. A sandbox enables a company to test, optimize, and identify potential problems before they spiral out of control. Examining test environments (sandbox) and obtaining separate access data for each.
   Each website should include a "testing sandbox"—a location where we can easily test the entire system's operation (e.g., make a test payment or connect a test payment card).

2. **Examining API Documentation of Products**
   Systems integrators that are ill-prepared for API integration may face roadblocks that drive up costs while delivering only incremental results. Examining products' API documentation enables service integrators to understand how the API data works, what protocols it employs, and what possibilities it provides (e.g., if it will notify itself when it performs an action or repeat the action in case of an error).

3. **Large Scale Testing**
   System integration services always perform complex testing before the system goes live to eliminate potential errors. Making and following a checklist is one of the critical system integration challenges because it is easy to overlook various details. Testing various scenarios is an excellent way to check for every possible situation and improve work quality.

Examples of Systems Integration

Companies today have a range of methods available they can access to connect systems and tools. Some of the most common connectors include things like middleware for connecting disconnected data, application programming interfaces (APIs), and webhooks or HTTP call-backs. They can also use electronic data exchange systems for the same purposes.

Systems integration strategies can also involve various models. For example, a point-to-point model involves extracting data from one system and submitting it to another environment automatically. Meanwhile, a hub-and-spoke model uses a central hub to sort through the data collected from each environment and deliver it in a useful format for business leaders.
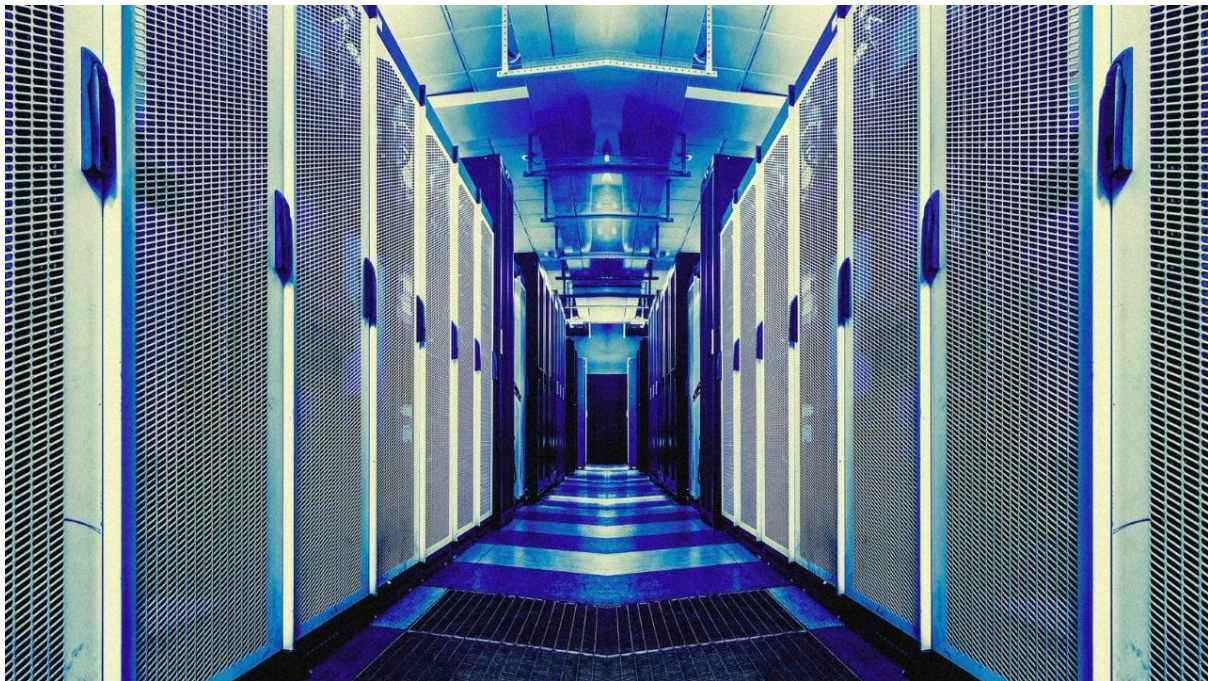
The unified environment would pull data from each tool leveraged by the company, without requiring them to access the software solutions separately, allowing for better end-to-end visibility, and improved productivity for the team.

System integration touches mutliple aspects of any organization, so there are many real-world examples across different industries. Here are a few to illustrate the concept:

1. Inventory Management & Point-of-Sale (POS) Integration

 Imagine a retail store connecting its inventory management system with its POS system. This allows real-time updates on stock levels whenever a sale is made. The system can automatically trigger purchase orders when inventory falls below a certain threshold, preventing stockouts and lost sales.

2. CAD & Manufacturing Execution Systems (MES) Integration

In a manufacturing setting, integrating Computer-Aided Design (CAD) software with the MES can streamline production processes. The MES receives product design data directly from CAD, eliminating errors and ensuring production follows the exact specifications.

3. Banking Systems & Accounting Software Integration

Banks can integrate their core banking systems with accounting software used by their corporate clients. This allows for automatic data exchange between the two systems, such as account balances and transaction details. This streamlines reconciliation processes and reduces manual data entry errors.

4. Electronic Health Records (EHR) & Appointment Scheduling Systems Integration

Hospitals can integrate their EHR systems with appointment scheduling systems. This allows patients to view their medical history, book appointments, and manage their healthcare information online. Additionally, doctors can access a patient's complete medical record during appointments, leading to better-informed treatment decisions.

5. CRM & Marketing Automation Integration

E-commerce businesses can integrate their CRM systems with marketing automation platforms. This allows them to target marketing campaigns based on customer data stored in the CRM. They can send personalized emails, recommend relevant products, and improve the overall customer experience.

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